

# **DEVELOPING THE HORTICULTURAL EXPORT INDUSTRY IN RWANDA**

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## **1. INTRODUCTION**

During a visit to the Chemonics-ADAR project in Rwanda in March and April 2002, constraints to the development of fresh fruit exports were identified and recommendations given for ways of surmounting the most important obstacles. Training of Rwandans on various aspects of fruit production, particularly for passion fruit, as well as all aspects of post harvest handling of fruit destined for export to the EU formed a major component of the recommendations; in order to begin these training activities, and supervise the first shipments of passion fruit to the EU, I returned in May 2002. Given the need for Rwandan exporters to eventually have a diversified range of commodities on offer, this trip also served as an opportunity for me to look into new horticultural crops which could potentially be produced for export to EU and other international markets. The following is a summary of what was accomplished over the seven weeks I spent in Rwanda, along with my suggestions for ways of further improving the horticultural export industry.

## **2. LAUNCHING OF PASSION FRUIT EXPORTS BY GERARD SINA**

### **2.1. Grading and packing operations**

During my absence, little progress appeared to have been made on the part of improving the physical facilities along with staff capabilities for grading and packing passion fruit for export. Despite having assured me a dedicated packing area would be set up, no changes had been made and plans were to continue using the small, unventilated room where fruit are stored to also grade and pack the fruit. A compromise was reached with Mr. Sina agreeing to allow the fruit grading and packing take place on a veranda which is normally used to process the passion fruit into juice. The site is not ideal (still used for juicing when grading and packing were not underway, and less than hygienically clean, only partially shaded from the sun, only one entrance/exit which prevents the desired flow-through set up), but allowed us to conduct the grading and packing for the small volumes of fruit exported in the initial stages.

Another factor limiting the speed and capacity of the grading/packing operations was the lack of a sufficient number of trained staff; I conducted a special training session prior to the date the second shipment was to go out, and found that the group worked most efficiently when each member was specialized for a given task, i.e. for the initial sorting and trimming, or for the final grading and packing. They still worked at a slow pace, and seemed to require my supervision in order to prevent careless mistakes.

## **2.2. Recommendations to improve grading and packing operations:**

1. Increase the number of staff trained to conduct these operations and put one person in charge of monitoring their work in order to ensure mistakes do not occur (e.g. fruit which are not up to export standards being packed and sent out, leaving packed boxes in the sun, etc.). Consider training women for the grading and packing, as is found in horticultural pack houses throughout Africa, due to their tendency to pay greater attention to detail and handle produce more carefully. Develop visual aids such as photographs of acceptable and non-acceptable fruit, the optimum way to fill a box, etc. to assist the workers during the grading and packing operations.
2. Set up the grading and packing operations in a dedicated pack house: design of same should allow for unidirectional flow of produce, maintenance of required hygiene standards, greater worker comfort and better regulation of temperature (preferably in combination with evaporative cold storages, or even refrigerated cold stores, constructed in close vicinity to pack house). The pack house should have a sufficient surface area for grading with tables set at a height which is comfortable for the workers, be well lit for grading, have holding containers which minimize damage to fruit (e.g. shallow wooden crates rather than deep plastic buckets), cleaning and trimming tools (clothes damped in a dilute chlorine solution for wiping dirty fruit, clippers to trim fruit peduncle rather than scissors), and be located away from areas where pollutants such as smoke, vehicle exhaust occur and/or where there are a lot of other activities which could potentially threaten the hygiene of the pack house (e.g. production of food/feed stuffs which attract flies and rodents).

## **2.3. Fruit supply**

The first shipment of passion fruit was ten boxes short of the targeted 100 agreed with VegPro, and the second even poorer in that only enough fruit was procured to put together 60 boxes of export quality<sup>1</sup>. Part of the shortage was due to the low packout rate (less than 50% of fruit delivered were exportable), which resulted from a combination of factors, listed in decreasing order of importance: disease, especially *Alternaria* and *Septoria*, under ripe fruit, desiccation of fruit (long lag between harvest and grading, with fruit held under warm, dry conditions, and to some extent fruit apparently exposed to sun during harvest and transport operations), fruit damaged during harvest/post harvest handling (e.g. much of the fruit were stored in deep plastic bins, with the result that the fruit skin was broken or bruised from compression), under size fruit, misshapen fruit.

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<sup>1</sup> The subsequent shipments saw a gradual increase, with 100, 125 and 130 boxes sent out on the third, fourth and fifth shipment dates, due to a combination of larger procurements of fruit and improved handling at the level of Sina's operations.

The incidence of disease was probably exacerbated by the heavy rainfall experienced during the previous month, along with the already observed poor/lack of disease management practices of most passion fruit producers (c.f. Diagnostic Survey Trip Report). The limited fruit supply could also be attributed to the normal cyclical nature of passion fruit production in Rwanda, with the period of May – end July known to have only small amounts of fruit on the market. In addition to the effect of rain on plant disease levels, rain also interferes with fruit set in passion fruit as wet pollen grains burst before germinating, and the insect pollinator activity is much lower.

## **2.4. Recommendations to increase supply of export quality fruit<sup>2</sup>**

1. In the short term, providing producers with information on selection of fruit at harvest, use of better harvesting containers (e.g. clothe-bag model from Zimbabwe's Nyanga Fruit Experiment Station) and convincing them of the importance of storing harvested fruit in a shaded/cool area along with finding a transport container which minimizes damage to fruit in transit (e.g. shallow wooden crates lined with protective material) and making these available to the producers. If conducted in conjunction with establishing a two tiered price system, with a higher price paid for higher quality (potentially exportable) fruit, producers would have an incentive for adopting the recommended practices.
2. Setting up more evaporative coolers, if they are found to be effective, including in closer proximity to the plantations for interim storage (i.e. after harvesting and before transport to collection center).
3. In the long term, training producers on and setting up demonstrations of improved production practices so as to lead to larger quantities of high quality fruit:
  - Proper pruning and training of plants will reduce the level of disease, as well as scarring of the developing fruit. Fruit color may also be improved if the canopy is managed so as to allow better light penetration, and average size of fruit should increase due to a lower plant fruit load at any given time with selective pruning.
  - Improving the trellis structures by encouraging producers to remove all branches and leaves from the wooden poles that make up the trellis system. This should reduce fruit scarring as well as diminish the likelihood that unwanted vine growth will occur up the trellis (the latter favors disease development).
  - Improved hygiene practices in the field to reduce the occurrence and spread of disease.

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<sup>2</sup> Most of these recommendations are discussed in detail in the draft training manual in Appendix III, *Comment produire le maracuja pour l'exportation*.

4. Also over the long term, selection of seed from disease free plants, with an effort to select for better fruit quality overall, and training producers on improved seedling production practices should lead to an improvement in the supply of high quality fruit. I am attempting to start a pilot project along these lines with establishment of a new nursery for passion fruit at Mr. Sina's farm.<sup>3</sup>

### **3. NEW EVIDENCE OF SEVERITY OF DISEASE PROBLEMS IN PASSION FRUIT**

In addition to finding fungal diseases to be widespread in passion fruit, a trip to the Rulindo area (north of Kigali) revealed that Passion Fruit Woodiness Virus (PWV) is also present; the plantations belonging to one growers' association were all severely infected and to the extent that destruction of all plants was the only recommendation that could be given. Factors which may be contributing to this serious epidemic include the usual poor hygiene practices (new plantations established next to old ones, lack of wind breaks or other physical barriers between plantings, no sterilization of tools/worker's hands during pruning and other operations), along with the widespread occurrence of possible alternate hosts for PWV such as bananas and an abundance of weeds, and the cooler temperatures the plants would be subjected to at the higher elevation where plantations are found. Several publications have mentioned that the symptoms of PWV and its adverse effect on passion fruit growth are not seen until the plant is stressed, with "cold temperatures" being one type of stress frequently mentioned<sup>4</sup>. In addition to recommending destruction of infected plants (which in the case of Rulindo would mean destruction of all the plantations), planting passion fruit to small, isolated plots would help to minimize the spread of this, along with other diseases. Given the reaction to these and other suggestions I gave to the chairman of the growers' association, however, passion fruit producers are going to have to be convinced, most likely through field demonstrations, of the importance of following these recommendations to avoid disease outbreaks and ultimately realize good yields of high quality passion fruit.

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<sup>3</sup> The nursery will have a better location, being at a higher elevation at a distance from the stream, and therefore in less damp conditions than the previous site. Some of the seedlings are to be produced in polyethylene bags filled with potting mixture « steam sterilized » by boiling the mixture in a drum held over a fire for one hour, then keeping the mixture in a secluded spot for 3 weeks while toxic compounds which may have been released during the heating dissipate. These seedlings should not only be less likely to be infected by disease, they should develop a less profuse branching habit which will make them easier to prune and train in the desired fashion.

<sup>4</sup> See for example : Ondieki, J.J. 1975. Diseases and pests of passion fruit in Kenya. *Acta Horticulturae* 49: 291-293.

## **4. INVESTIGATION OF OTHER POTENTIAL EXPORT CROPS**

### **4.1. Bird's Eye Chillies**

Bird's Eye Chillie (*Capsicum frutescens*) is a crop which Rwandans may consider producing for the export market; this commodity is sold as a dry fruit, and is currently produced in countries such as Uganda and Zimbabwe for EU markets. Since the fruit is sold dried, it is relatively non-perishable (provided it is stored in a moisture-free environment) and would be easier for Rwandan producers to handle than horticultural commodities sold in the fresh form. Additionally, the high labor requirement for harvesting Bird's Eye Chillies in light of the relatively low cost of labor in the country would give Rwanda a competitive advantage in producing this crop. Some Rwandans are already growing Bird's Eye Chillies, and have made inquiries at ADAR for assistance in finding markets. In order to assess the quality of crops in the ground with a view to the export market, I visited one Bird's Eye Chillie grower's plot in Butare. The crop (belonging to Anselme Karayenzi) which has been yielding fruit for some months was found to be in good shape in terms of fruit quality and uniformity. A few of the plants appeared to have a viral infection (possibly Tobacco Etch or Potato Y), otherwise the crop was clean and highly productive. Some of the harvested fruit were being dried on a rack placed in the sun, with the result that fruit on the top of the rack were exposed to full sun, which is not recommended for fruit destined for export; covering the top with an opaque material to provide shade for the lower racks would rectify the problem. If market research reveals there to be a demand for Bird's Eye Chillies from Rwanda in the EU or other international markets, and the volume of production were to be increased, this may prove an interesting crop for Rwandan growers/exporters in the future.

### **4.2. Tamarillo**

Tamarillo (*Cyphomandra betacea*), also known as Tree Tomato and Prune du Japon, is widely grown throughout Rwanda. The fruit are larger and better tasting than those from Zimbabwe, which exports a small amount as fresh fruit, and may be of interest (albeit on a small scale) to European fresh produce importers. Consumption of tamarillo fruit is traditionally recommended by Rwandans for people suffering from stomach ailments, and some Europeans believe this fruit to be a "health food". There is a problem of what appears to be a virus affecting tamarillo plants in Rwanda, especially in areas where the crop has been grown for some time. A visit to a relatively young planting of the crop in Kabuga (which is not a traditional tamarillo growing area) revealed a small proportion of the plants were stunted, with puckered and mottled leaves; the cause could be a variant of a potato virus, cucumber mosaic virus or Tamarillo Mosaic Virus. Regardless of its identity is, the virus has potential to spread and seriously reduce tamarillo plant growth and yield of high quality fruit.

If a market for tamarillo is identified in the EU (perhaps exploiting its alleged health value), systems of production with improved disease management should be developed and extended to Rwandan producers.

## **5. FURTHER SUGGESTIONS FOR ADAR TO ENHANCE RWANDA'S HORTICULTURAL EXPORT INDUSTRY**

The PEARL project, based in Butare, expressed an interest in collaborating with ADAR on the development of horticultural crops for export in Rwanda. One activity along these lines was launched in June, with the construction of an appropriate technology charcoal cooler (used to store fresh produce) at the Tonga Farm of the National University of Rwanda (NUR) in Butare. Staff from the Faculty of Agronomy at NUR were involved in the construction, and expressed an interest in having PEARL/ADAR assist with setting up field demonstrations of horticultural crops with export potential at the Tonga Farm, with a view to using the demonstrations to instruct students on proper crop production and harvest/post harvest handling techniques. This could serve to disseminate information on horticulture to a wider group within the country, as well as allowing students the opportunity for "hands-on" experience which would prove valuable to those who may be engaged in the horticultural industry after graduation. Furthermore, information generated from the demonstration trials could be fed back to ADAR staff and incorporated into technical information given to ADAR clients interested in horticultural exports.

## A N N E X E S

## ANNEX 1. PHOTOGRAPHS OF VARIOUS ASPECTS OF HORTICULTURAL CROPS WITH EXPORT POTENTIAL



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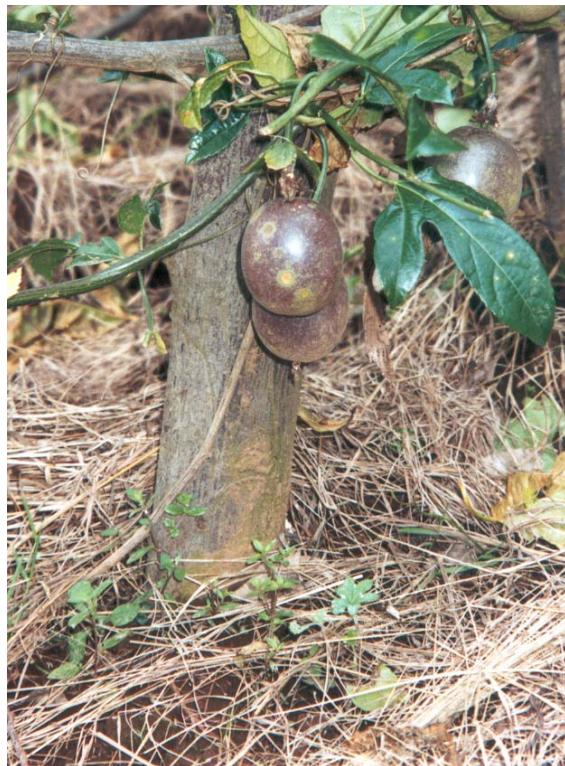


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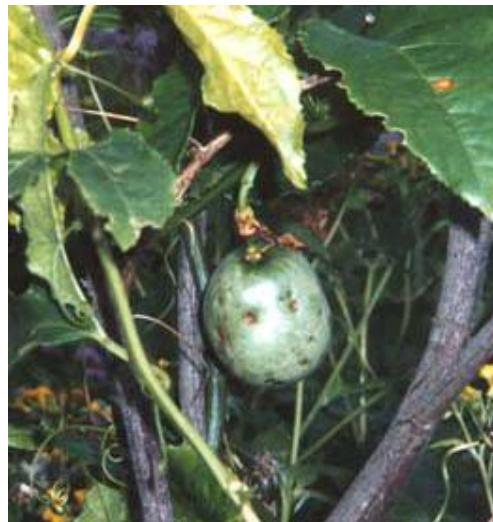


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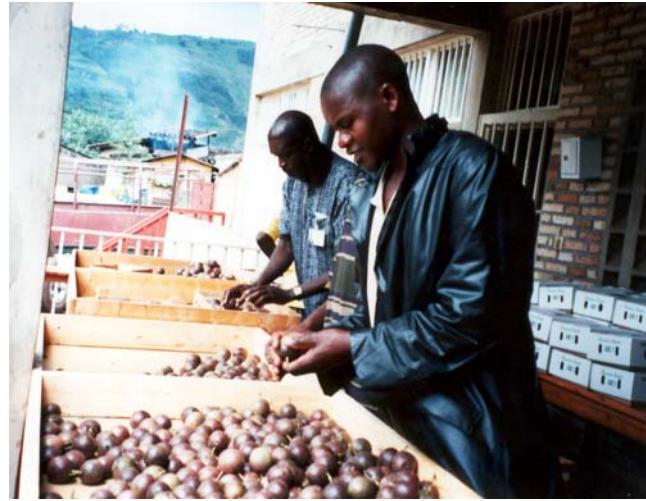
**Photographs 1-5.** Examples of passion fruit which lower the pack out rate for export of fruit from Rwanda (clockwise from top left) : fruit scarred during development on the plant and blotchy ripening, fruit scratched during careless harvest/post harvest handling, shrivelled fruit (over mature), fruit affected by the disease *Septoria* from field infection of the plant, and fruit punctured by packing into inappropriate transport/holding container.



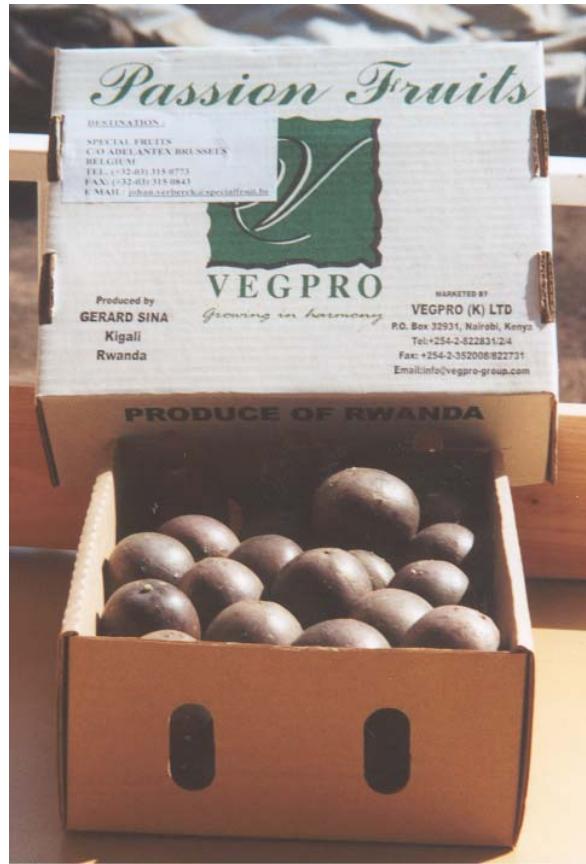
**Photograph no. 6.** One of the main reasons for the high percentage of passion fruit affected by disease in Rwanda is the failure of producers to properly prune and train the vines; allowing vines to grow close to the ground (rather than cutting them off at an early stage of development) facilitates infection of the plant, and often the fruit directly, by soil borne diseases.



**Photograph no. 7.** Passion fruit Woodiness Virus (PWV), for which there is no remedy other than destruction of infected plants, was observed to be widespread in plantations in the Rulindo area. A combination of poor hygiene practices which would facilitate disease spread, and the cooler than optimum temperatures of the growing are most likely the cause for the disease outbreak.



**Photograph n° 8.** Grading and packing of passion fruit for export from Gérard Sina's center of operations in Nyirangarama (Kigali North).



**Photograph n° 9.** Sample of passion fruit supplied by Gérard Sina to VegPro Limited for export to a fresh fruit importer in Brussels.



Photograph n°10. An example of a healthy and productive Bird's Eye Chillie plant grown by ADAR client Anselme Karayenzi in Butare; production of uniformly small, deep red fruit is essential to meeting export market standards.

## **ANNEX II: NOTES FROM TRAINING MEETINGS WITH PASSION FRUIT PRODUCERS**

### **21 June –First Training Meeting with Mr. Sina’s Passion Fruit Producers (Topic: Harvesting and Post Harvest Handling)**

Approximately 150 people were present by the end of the meeting, with the bulk of the audience being men. Questions/comments pertinent to the subject of proper harvest and post harvest handling techniques were as follows:

- If fruit are left on the plant up until the development of purple coloration, they either fall on the ground before they can be harvested, or are stolen (response: harvest before fully purple, as long as about 75% purple; discuss theft problem with neighbors and solve it amongst yourselves)
- Many plants yield fruit which are not purple in color – what should be done with these plants? (response: uproot them as soon as you note they are producing fruit of the wrong color – the fruit simply cannot be sold for export).
- What to do with good fruit which are not ripe on Wednesdays/the days just following Tuesday when fruit are collected for export – could they be stored until the following Tuesday? (response: storage in evaporative cooler would not keep fruit that length of time; if at some point in the future the export of fruit reaches a high level it may be possible to construct a refrigerated cold storage, but that is not likely in the near future).
- Comment that the fruit with a scratch mark was probably too high to pick and therefore knocked down with a stick, followed by question of whether or not the fruit skin “really mattered” (response: try to harvest fruit out of reach more carefully; superficial wounds don’t cause rotten fruit, deeper ones do and both are unfortunately not acceptable for the export market).
- Many general questions on how they should go about producing the quality of fruit that is being sought for export (response: combination of proper handling after harvest, along with changes in the way plants are pruned and trained, plus eventually through continued selection of seed from healthy plants with good fruit).
- How does Rwandan passion fruit compare in quality with that from other countries, and in what ways are fruit from other countries better? (response: better than Kenyan, but not as good as Zimbabwean passion fruit, which are larger and more fully purple in color – Rwandans should with changes in pruning and training, along with disease management practices be able to produce fruit more like those of Zimbabwe in the future).

***Other questions/comments pertaining to other aspects of passion fruit production:***

- Plants are “good” when taken from the nursery and planted, but then degenerate some time after having been transplanted (response: likely due to disease and pest problems – techniques to reduce these to be discussed starting with the next meeting).
- Soils are “no longer giving good plants” – what can be done to improve them (response: if a sufficiently long rotation to other crops, especially leguminous crops, is practiced after growing passion fruit, they should be able to get good passion fruit crops from the same piece of land; but at least three years should lapse between crops of passion fruit).
- Request for wire to use in trellising (response: good fruit can be produced using trellis made entirely of wood – problem with current wooden structures is the presence of many branches, twigs and leaves; if all extraneous materials are trimmed from poles before the trellis is put up, there will be less damage to the fruit).
- Is there any “medicine” which can be applied to the plants to cure the diseases (response: no, but changes in cultural practices should reduce the disease problems; diseases in passion fruit should be considered like AIDS in humans: the most important thing is to prevent the diseases from occurring, as there really is no cure once plants are infected).

There were many questions and comments concerning the price paid for passion fruit (with many appearing unhappy with the present price); also some questions on the length of the contract they had signed and whether or not the agronomists would visit their fields to show them better cultural practices. I responded by informing them I could only provide them with technical advice, and that all other issues needed to be taken up with Sina.

**26 June – Second Training Meeting with Mr. Sina’s Passion Fruit Producers (Topic: Disease and Pest Management in the Field)**

Approximately 90 people were present by the end of the meeting, with women making up about one third of the participants. The topic was presented by drawing an analogy between HIV/Aids in humans and diseases in passion fruit: once a plant is infected, there is no “cure”, therefore the strategy should be to prevent plants from becoming infected in the first place. Questions/comments pertinent to the subject of passion fruit disease and pest management were as follows:

- What is the minimum distance which should be allowed between old and new plantings of passion fruit (response: first must consider whether new planting will be up or down wind of old one, with the former option being preferable, and secondly whether or not wind breaks are planted around the passion fruit plots; in this situation, a minimum distance of 50 m is advised)

- Given that so many of the plants are already infected with diseases, where are fruit from healthy plants (from which to extract seed for planting the next crop) to be found (response: first make a thorough search to find at least a healthy fruit, even if the mother plant has some indication of disease infection, secondly inspect the seedlings regularly to be certain of catching any infected ones and roguing them out of the nursery as quickly as possible. Attempts are being made to set up a nursery with improved seedling production at Sina's, so healthy seedlings may be available to producers in time for September's planting).
- Do ALL the leaves which fall onto the soil in the plantation have to be collected and removed (response: only those with signs of disease)
- There was much discussion on the use of chlorine in water to disinfect hands and tools to reduce disease spread throughout a plantation, or from one to another. The farmers did not seem to think this practice would be too expensive, and were mainly curious about chlorine (what would happen if someone drank it, where does it come from, is it a "medicine", etc). Some practical questions on the length of time a solution of one capful of bleach in one liter of water could be used (response: if no signs of disease in plantation, after every 30 plant; if some signs of disease, should change solution after every 10 plants), where to discard the solution (response: outside of the plantation, where it won't end up running into another passion fruit plot)
- There was also much discussion on the recommended system of pruning and trellising, and concern that yields would be reduced if so many of the plant vines were pruned off. Tried to explain that by having a larger, healthy plant before fruit setting commenced, the overall yield and quality of fruit would be higher.
- Where to find the polyethylene sacs recommended for producing seedlings (rather than seed beds)? (response: samples have been given to Sina's agronomist, and should be available for them to see and from this make models for their own use; any sort of plastic container, e.g. those used for fruit juices, yogurt, etc.; the principal is to grow seedlings in containers in order to reduce risk of disease spread throughout the nursery, and to produce stronger seedlings which will be more resistant to diseases when planted out in the field.

***Other questions/comments on other aspects of passion fruit production:***

- Many concerns about the soil fertility: 1) soil on hills poor in nutrients vs. those of marais, should passion fruit not be planted in the latter rather than former (response: no as passion fruit must have good drainage, which is provided on the hills but not in the marais; hill soil fertility can/should be improved with rotations to leguminous crops); 2) Could cause of some plants having red fruit (rather than the purple desired) be due to the type of soil plants are grown on

- (response: no, entirely a genetic factor, to be corrected by roguing out off-type plants as soon as their presence is detected in order to reduce the frequency of their occurrence in future plantations);
- 3) When should manure be applied to already established crops, and how to do it without damaging the roots (when manure dug in) (response: apply as they are doing already, i.e. at flowering, and whenever the plants start to become yellow; dig manure into shallow circular trench a distance of 50 cm from the base of the plant, and cover with a mulch).
- How to reduce loss of/damage to roots of seedlings taken from seedbeds at transplanting (response: use sufficiently wide spacing between seedlings in the bed so that there is room to lift up the soil around the roots when uprooting the seedling; wider spacing also desirable to promote development of stronger seedlings and reduce disease transmission in the seedbed).

## **ANNEX III: TRAINING MANUAL PREPARED FOR PRODUCERS AND EXPORTERS OF PASSION FRUIT FROM RWANDA**

### **COMMENT PRODUIRE LE MARACUJA POUR L'EXPORTATION** Anne Turner, Horticultural Consultant, ADAR

*Les producteurs de maracuja au Rwanda ont besoin de changer leur façon de penser à la production de ce fruit. Au lieu de produire des grandes quantités de fruit de qualité moyenne ou pauvre, il faut accentuer la production des petites quantités de fruits de très bonne qualité, ce qui est exigée sur le marché européen. On peut réaliser ce but en employant une combinaison de techniques. Afin de comprendre pourquoi on doit changer les systèmes de production et de manutention de maracuja, il vaut mieux comprendre pourquoi les systèmes en place à ce moment ne donnent pas les fruits de la qualité exigée par les importateurs en Europe.*

#### **Problèmes avec les systèmes actuels**

1. Manque de bonne gestion de la croissance de la plante.
2. Manque de suivi des pratiques de bonne hygiène aux champs.
3. Besoin pour des systèmes améliorés pour le tuteurage
4. Manque de connaissance des pratiques appropriées pour la récolte et la manutention des fruits du maracuja.

#### **Manque de bonne gestion de la croissance de la plante**

*Ce que font la plupart des producteurs est de laisser pousser la plante comme elle le fait naturellement, avec peu de taillage et un système de tuteurage peu organisé. La forme de la plante qui en résulte est une voûte de feuillage épaisse. Cela n'est pas souhaitable pour plusieurs raisons :*

1. Avec une voûte de feuillage épaisse, il y a beaucoup d'humidité autour de la plante, ce qui favorise le développement des maladies chez la plante.
2. Les fruits ne sont pas bien exposés au soleil pendant la période de leur développement sur la plante, ce qui est nécessaire pour eux d'avoir la couleur violette foncée à la maturité.
3. Les jeunes fruits sont soufflés par le vent contre les lianes et les structures du tuteurage avec le résultat qu'ils auront les tâches ou les cicatrices, ce qui les rend non acceptables pour l'export.
4. Souvent, les lianes de la plante poussent sur le sol, ou bien très près du sol, ce qui favorise l'attaque par les maladies édaphiques.

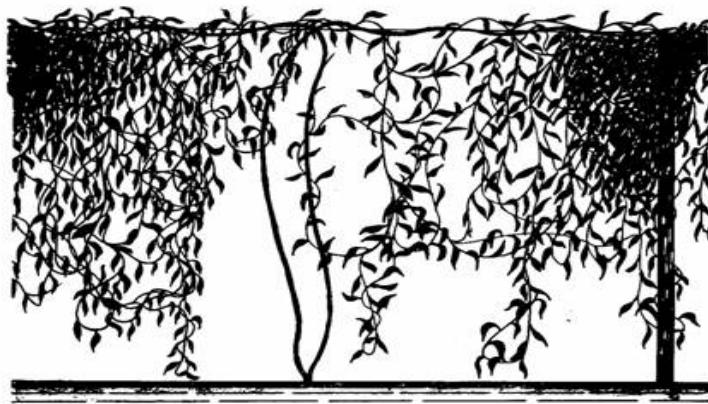
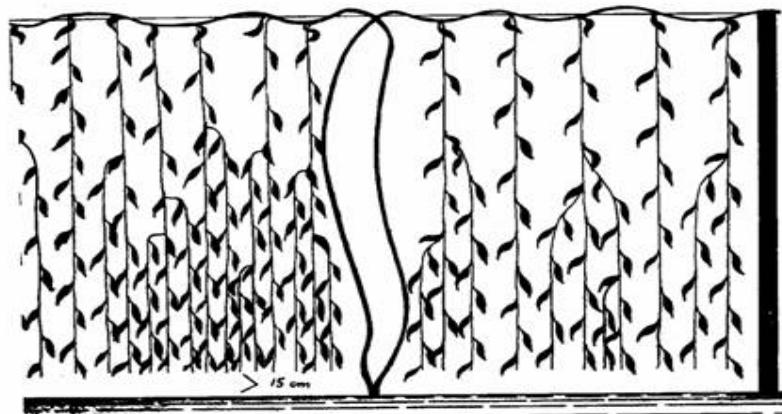


Fig. 34 This drawing shows the natural growth of the secondary shoots which ends in a kind of thicket.

*Alors, qu'est ce qu'on devrait faire afin de bien gérer la croissance de la plante ?*

1. On devrait commencer le taillage des plantes quand celles-ci sont encore petites ; on coupe les lianes faibles en laissant un tuteur central que l'on peut facilement amener vers le tuteurage. Dès que le tuteur est au même niveau que le premier support horizontal (à peu près 1 m), on peut y laisser 2 lianes secondaires que l'on amène vers le support. Toutes les autres lianes qui sortent du tuteur central doivent être coupées. Quand le tuteur central est au niveau du deuxième support horizontal (à peu près 2 m), on y laisse pousser deux lianes dans les sens opposés.
2. On doit régulièrement (chaque 2 semaines) démêler les lianes pour éviter la voûte de feuillage épaisse ; le résultat devrait être ce qu'on appelle un « rideau » de lianes.



3. Dès qu'une liane a donné des fruits, elle ne donnera plus de nouveaux fruits. Ces anciennes lianes doivent être coupées régulièrement ; cela stimule la production des nouvelles lianes qui donneront des fruits. En coupant les anciennes lianes, on peut éviter le développement d'une voûte de feuillage épaisse.

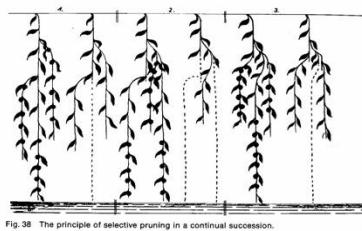


Fig. 38 The principle of selective pruning in a continual succession.

4. Au lieu de semer le maracuja dans les « lits de semence », il vaut mieux mettre les semences dans les sachets ou les pots. Les plantules qui poussent dans les sachets/pots ne donnent pas les lianes abondantes comme les plantules viennent des lits de semence. Donc, le taillage est beaucoup plus facile et l'on a plus de chance de réaliser la forme de croissance chez la plante désirée.<sup>5</sup>

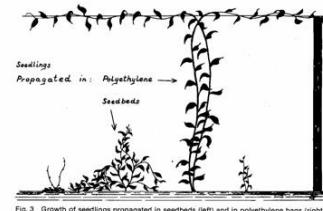


Fig. 3 Growth of seedlings propagated in seedbeds (left) and in polyethylene bags (right).

### ***Le manquement de suivre les pratiques de bonne hygiène aux champs***

1. Une très mauvaise habitude chez beaucoup de producteurs de maracuja est de mettre une jeune plantation à côté ou très près des anciennes plantations. Comme les anciennes plantations sont (d'habitude) pleines des maladies et des insectes ravageurs, ils sont facilement transmis aux jeunes plantules. Malheureusement, celles-ci ont peu de résistance et, donc, deviennent infectées quand elles sont toujours très jeunes. Le résultat est que la nouvelle plantation ne donnera jamais de bons rendements, et, en plus, le producteur augmente le niveau des maladies et des insectes dans sa région. Le plus souvent qu'on répète ce cycle, le problème devient plus grave.

<sup>5</sup> Il y a d'autres avantages des plantules venant des sachets/pots: elles sont plus fortes et en meilleure santé en comparaison avec des plantules des lits de semence. La croissance après le repiquage est plus vite, et il y a moins de pertes.



2. Parmi plusieurs producteurs de maracuja, les parties des plantes, ou bien des plantes entières qui sont infectées par les maladies ne sont pas sorties de la plantation. On parle ici des fruits pourris et des feuilles qui sont tombées par terre, les lianes tuées par les maladies, et même des plantes entières. Quand on laisse les matériaux infectés dans la plantation, les maladies se multiplient et sont rapidement transmises dans toute la plantation, et aux plantations avoisinantes
3. Les producteurs eux-mêmes peuvent contribuer à la transmission des maladies et des insectes, d'une plante à une autre dans une plantation et d'une plantation à une autre. Quand quelqu'un travaille dans une plantation où il y a des maladies et des pestes, il risque toujours de porter les maladies/pestes sur ses mains, ses outils, etc. chez une plante (une plantation) saine.
4. On DOIT faire la rotation du terrain où sont cultivées les plantes de maracuja. Et la période de la rotation doit être suffisamment longue afin de diminuer le niveau des maladies et des pestes de maracuja, c'est-à-dire trois ans minimum. C'est très important d'inclure des cultures légumineuses dans le cycle de rotation afin d'améliorer la fertilité du sol..
5. Les plantes hôtes pour les mêmes maladies et pestes qui attaquent le maracuja ne doivent pas pousser dans, ou tout près de, les plantations de maracuja. On parle ici surtout des plantes de la famille cucurbitacée, comme le potiron, le concombre ; si on les trouve, on doit les arracher et les détruire.

*Le niveau des maladies chez le maracuja au Rwanda est en train d'augmenter tellement vite qu'on trouve des régions où les maladies sont non maîtrisables. La raison pour cette catastrophe est surtout le manquement de suivre des pratiques de bonne hygiène aux champs. Si les producteurs ne changent pas leurs pratiques le plutôt possible, on risque d'avoir des endroits où l'on ne pourra jamais plus cultiver le maracuja.*

***Quelques exemples des maladies les plus sérieuses chez le maracuja :***



« Tache brune » (*Alternaria passiflorae*) : un champignon qui attaque les feuilles, les lianes et les fruits.  
Les fruits touchés par cette maladie ne peuvent pas être exportés.



« Anthracnose » (*Colletotrichum gloesporioides*) : Un champignon qui peut infecter la plante par les blessures ou des parties de la plante coupées. Dès que cette maladie entre dans la plante, elle tue le tissu près de la blessure où elle est entrée, et s'épand vers la base de la plante, avec le résultat que la plante est tuée.



« Septoria » (*Septoria passiflorae*) : un champignon qui attaque les feuilles, les lianes et les fruits. Même une infection légère peut causer la chute des feuilles et des fruits.



« Le durcissement de la plante (Passion Fruit Woodiness Virus) » : une virose sérieuse chez le maracuja qui cause une restriction de la croissance de la plante, et qui donne des fruits plus petits que d'habitude, qui sont mal formés et avec une écorce épaisse, souvent avec des fissures. Cette virose peut être gardée par des plantes comme le potiron et le concombre, la banane et plusieurs mauvaises herbes, et est transmise par les insectes (les pucerons) chez le maracuja.



La transmission se fait très souvent mécaniquement, avec les outils qui sont employés sur les plantes saines après avoir travaillé sur une plante malade, sans avoir désinfecté les outils.

### ***Les techniques pour lutter contre les maladies et les parasites chez le maracuja***

1. Situer les nouvelles plantations de maracuja loin des anciennes. S'il y a du vent qui souffle régulièrement d'un sens, les nouvelles plantations devraient être placées dans le sens opposé au vent par rapport aux anciennes plantations.
2. Planter des brise-vent au tour des plantations ; cela peut réduire la transmission des pestes et des maladies d'une plantation à une autre. Les plantes du brise-vent peuvent aussi servir comme refuge pour les ennemis naturels des parasites du maracuja.
3. Suivre un programme de rotation aux autres cultures pour une période d'au moins trois ans afin de réduire le niveau des maladies et des pestes sur le terrain.
4. Inspecter régulièrement la plantation pour les signes des maladies et des insectes ; couper (ou arracher) les parties des plantes (ou les plantes) infectées, et sortir les déchets de la plantation, puis les brûler. Il faut faire attention de ne pas laisser les fruits et feuilles attaqués qui sont tombés par terre. Il faut aussi inspecter régulièrement la pépinière et arracher/enlever les plantules qui ont des indices des maladies.
5. Couper toutes les lianes qui sont sur/près du sol.
6. Suivre quelques règles simples de l'hygiène :
  - Désinfecter les outils, et même les mains après avoir travaillé dans une plantation avant d'aller dans une autre. Vous pouvez utiliser une solution d'eau mélangée avec eau de Javel (un bouchon dans un litre d'eau) pour la désinfection.
  - Commencer le travail dans les plantations jeunes, et puis aller travailler dans les autres plantations qui sont plus anciennes.
  - Eviter de blesser les plantes ; chaque blessure peut servir comme point d'entrée pour une maladie.
  - Sortir tous les matériaux de la plantation qui sont coupés.
  - Ramasser régulièrement les fruits, les feuilles et les lianes attaqués qui sont tombés par terre ; les sortir de la plantation et les brûler.
7. Couvrir tout le sol de la plantation avec un paillage épais ; cela a l'effet de :
  - Réduire l'éclaboussure des maladies édaphiques sur la plante
  - Encourager les micro-organismes bénéfiques dans le sol, qui peuvent supprimer les maladies édaphiques

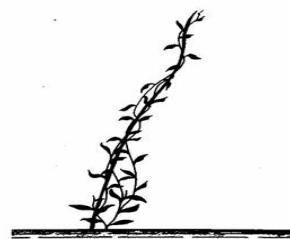


- Empêcher l'insecte « thrips » de sortir du sol (la nymphe grandit dans le sol).
8. Améliorer la production des plantules :
- Situer la pépinière dans un endroit isolé (c'est-à-dire, loin des plantations).
  - Sélectionner et ne semer que les graines dont la plante-mère est en bonne santé.
  - Si possible, semer les graines dans les sachets/pots. Si l'on est obligé d'utiliser les lits de semences, laisser un écartement assez grand entre les plantules (ne pas mettre trop de graines, enlever les plantules où elles sont trop près l'une de l'autre).
  - Inspecter régulièrement la pépinière pour les plantules qui ont des indices de maladies ou d'insectes ; les sortir de la pépinière et les détruire.
9. Inspecter régulièrement la plantation pour les « plantes hôtes » des maladies du maracuja comme le potiron et le concombre, afin de les arracher et les sortir de la plantation. Ne pas mettre les plantations de maracuja près des bananes, et de suivre un programme régulier de sarclage afin de diminuer le risque de transmettre le Passion fruit Woodiness Virus des mauvaises herbes aux maracuja.

#### ***Le besoin pour des systèmes améliorés pour le tuteurage***

La plupart des producteurs du maracuja emploient un système de tuteurage fait entièrement de bois, surtout le bois d'eucalyptus. Quand les plantes de maracuja sont grandes, les tuteurs commencent à être détendus ou à s'écrouler. En plus, avec ce système de tuteurage il est difficile de réaliser la forme de croissance de la plante voulue, et les fruits sont souvent blessés quand le vent les souffle contre les tuteurs. Les recommandations pour améliorer le système de tuteurage sont les suivantes :

1. Enlever au couteau toutes les branches et les feuilles des tuteurs qui font partie du tuteurage. Cela est très important pour réduire la quantité des fruits qui deviennent blessés pendant leur croissance.
2. Tout de suite après le repiquage, guider les lianes vers un tuteur simple ; puis, construire le tuteurage autour de la plante.



#### ***Manque de connaissance sur les pratiques appropriées pour la récolte et la manutention des fruits de maracuja***

Ce qui arrive le plus souvent est que les fruits ne sont pas bien sélectionnés à la récolte, avec le résultat que les fruits qui sont malades ou qui ont des cicatrices, ou qui ne sont pas mûrs, sont mélangés avec les fruits de bonne qualité qui pourraient être exportés. Les fruits sont sujets à la

manutention brutale pendant la récolte et le transport, ce qui les endommage. En plus, les fruits sont le plus souvent stockés dans un environnement peu aéré et à des températures élevées ; ainsi, les fruits commencent à se détériorer très vite. Dans les salles de triage et d'emballage, les règles d'hygiène ne sont pas respectées, et il n'y a pas de mesures de sécurité. Les suggestions pour améliorer les pratiques de la récolte et la manutention des fruits sont les suivantes :

**1. Sélection des fruits dès la récolte :** les critères sont les suivants:

- La couleur du fruit doit être violette sur 75-95% de la peau (pas de vert, mais pas violet trop foncé) ; il ne peut pas y avoir des signes de maladies, ni des insectes, ni des taches.
- Le fruit ne doit pas avoir des rides (indice de maturité trop avancée).
- Le fruit doit être intact et bien ferme (il ne faut donc pas tirer le fruit du pédoncule au moment de la récolte).

**Les fruits qui ne répondent pas à ces critères ne doivent pas être récoltés avec les fruits destinés à l'export**

**Exemples de fruits non-acceptables pour l'exportation :**



**Fruit cicatrisé et fruit avec une tache verte**



**Fruit attaqué par une maladie**



Fruit éraflé par la mauvaise manutention pendant ou après la récolte



Fruit contusionné par la mauvaise manutention



Fruit ayant commencé à flétrir

## **2. Techniques à suivre à la récolte :**

- Mettre les fruits dans les récipients qui ne feront pas l'écorchure sur la peau.
- Ne mettre que de petites quantités de fruits dans le récipient en une fois afin d'éviter de les écraser.
- Il faut éviter aussi que la chaleur monte dans le récipient ; donc, il faut le vider régulièrement en mettant les fruits dans le récipient de transport (de la plantation au point de collection).
- Laisser les fruits récoltés à l'ombre ; ils peuvent être couverts avec un tissu mouillé (le jute, le coton, par exemple) afin de se refroidir par l'effet d'évaporation.

## **3. Transport des fruits au point de collection :**

- Si les fruits sont portés à la tête, le récipient de transport devrait être tel que les dégâts aux fruits (à cause des mouvements du transporteur) sont empêchés, ou bien réduits au minimum.
- Le transporteur devrait éviter de cahoter car les mouvements peuvent amener aux blessures des fruits.
- Comme toujours, il vaut mieux couvrir les fruits avec le tissu mouillé afin de les protéger contre la chaleur.

## **4. Au centre de collection des fruits :**

- Il faut soigneusement verser les fruits du récipient de transport dans le récipient de collection. Il ne faut pas laisser tomber les fruits sur les surfaces, comme cette action peut amener aux blessures des fruits.
- La surface du récipient ne doit pas avoir les taches abrasives, ni des échardes, ni des clous qui peuvent blesser les fruits. C'est important de bien laver la surface du récipient avec une solution de l'eau de javel entre les lots différents des fruits afin de tuer des maladies et des insectes.

## **5. Pour le triage et l'emballage :**

- Bien sélectionner les fruits afin de **ne mettre dans les cartons que les fruits avec la qualité exigée pour l'export.**
- Couper le pédoncule du fruit avec des ciseaux ou des couteaux bien aiguisés ; faire attention de ne pas blesser le fruit, ni soi-même.
- Trier les fruits afin qu'ils soient uniformes pour les caractéristiques suivantes : couleur, taille et forme.
- Mettre au rebut les fruits qui ont des indices des insectes ou des maladies, qui sont blessés ou qui montrent le flétrissement. Les fruits sales ne doivent pas être parmi les fruits destinés pour l'export.
-

- Les cartons ne doivent être ni trop-pleins ni sous pleins des fruits. S'il y a trop de fruits, ils risquent de s'écraser. S'il y a des espaces vides dans le carton, les fruits peuvent se blesser par les mouvements pendant le transport.

**Attention : Vous avez intérêt à faire le triage et l'emballage des fruits le plus tôt possible après les avoir reçus, et de stocker les cartons de fruits dans un endroit frais et bien aéré jusqu'au moment où vous les chargez sur le camion pour les transporter à l'aéroport.**

#### **6. Stockage des fruits emballés :**

- Manier les cartons contenant les fruits soigneusement afin d'éviter la blessure des fruits.
- Les chambres où les fruits sont stockés doivent être bien aérées, et ne pas avoir de la moisissure sur les murs, le plafond, etc.
- Il faut éviter les endroits où les fruits sont exposés à la fumée ou des émanations des moteurs.

#### **7. Transport des cartons à l'aéroport :**

- Mettre les cartons des fruits sur le camion soigneusement pour le transport à l'aéroport. Ne pas les laisser tomber ni les jeter ou les frapper.
- Il vaut mieux faire le voyage le matin quand il fait encore frais.
- Conseiller le chauffeur de rouler lentement sur les routes rugueuses.
- S'il pleut (ou s'il y a risque de pluie), il faut protéger les cartons avec une couverture imperméable.